COURSE OUTLINE

(1) GENERAL

SCHOOL			
ACADEMIC UNIT			
LEVEL OF STUDIES			
COURSE CODE	A1	**SEMESTER**	1st
COURSE TITLE	**Fundamentals of Circular Economy and Industrial Ecology**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Add rows if necessary. The 1rganization of teaching and the teaching methods used are described in detail at (d).		8

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*specialized knowledge*
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The level of the learning outcomes corresponds to level 6 and 7 of the EQF.
Upon successful completion of the course, students will be able to:

1. Identify the connection of the energy and environmental aspects of the design process of a product/system, during the total life cycle of a product.
2. Analyze various components and methods for reducing the impact of a product or equipment in the environment during the different phases of its life cycle.
3. Analyze the Energy Efficiency, EcoLabel, EcoDesign, RoHS and WEEE Legislation.
4. Be able to perform Life Cycle Analysis and Life Cycle Costing Analysis during the design of a product and calculate the Total Cost of Ownership.
5. Combine the Concepts and Methodologies and Basic Tools for the Energy efficiency and Eco Design of Products.
6. Identify the material cycles and circularity in products and industrial processes.
7. Identify and analyze the wastes and waste streams as resources.
8. Identify the Economics of Energy Efficient Design and EcoDesign of products and systems.

9. Identify the Consumer Orientation - Innovation through Eco-Design, and circularity in the economic activities based on the total life cycle analysis approach.
10. Identify the circularity approaches in economy through products and services analysis and improvement.
11. Identify the importance of Repairability, Reusability and Recyclability.
12. Combine methods and approaches to achieve Repairability, Reusability and Recyclability.
13. Combine methods for developing and adapting strategies for Eco design and circularity of products and systems through analysis of all phases in their life and reverse engineering approaches.
14. Integrate RES into the energy efficient and ecological/sustainable design process or during improvement schemes for systems and products.
15. Perform the studies and work and assess their results considering this parameter.
16. Use the principles and methodologies of energy efficient and ecological / sustainable design (Eco-Design) in his/her professional activity.
17. Able to adopt circularity activities in his/her professional activity.
18. Identify the potential for adopting the principles of Industrials symbiosis and adopt circular approaches in industrial processes.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at fostering the following capabilities: Search for, analysis and synthesis of data and information, with the use of the necessary technology Decision making Independent work Work in a multidisciplinary environment Project planning and management Respect for the natural environment Production of free, creative and inductive thinking	

(3) SYLLABUS

This course offers an introduction to Circular Economy, starting off with the limits of the current system and describes how circular thinking can offer a promising alternative. Circular Economy is presented, on the basis of designing a new approach on transforming wastes of one process as the input to another, towards the key approach, that in the system under investigation the wastes produced are zero. The wastes as resources and the materials and energy recovery from different waste streams will be presented and analyse as it is the core of circular economy. The role of the 3Re approach (Repairability, Reusability and Recyclability) will be analyze and presented in the context of circular economy. The principles, the methods and the tools for achieving circularity in the economy can be achieved. The required novel thinking is presented under the context of industrial systems as basic and key actors in the effort. The critical role of ecodesign will be presented and the approach of transforming wastes as resources will be explained, through materials and energy efficiency. The role of Industry and Industrial Ecology and ecosystems will be analyzed as a successful approach towards the specified efforts. The focus will be also on material cycles and energy flow, as the two most successful case studies in the Industrial ecosystems. Case studies involving the transition from a linear to a circular approach in terms of products and processes will be presented, focusing on the market result and consumer benefits.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Blended course using Face-to-Face, Distance Learning for invited lectures,
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Teaching using ICT, Communication and Electronic Submission
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures	30
study and analysis of bibliography	60
project	120
Course total	210

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Evaluation Language : English **Theory** Final Written Exams: 100% **Individual Project** Final report + presentation : 100% The grade of the course is 60% x Theory + 40% x Individual project The individual project can be executed in teams of 2 persons or individually (project grade x1,05)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Delphine Gallaud, Blandine Laperche, Circular Economy, Industrial Ecology and Short Supply Chain, ISBN: 978-1-119-30747-1 June 2016 Wiley-ISTE, https://www.wiley.com/en-us/Circular+Economy%2C+Industrial+Ecology+and+Short+Supply+Chain-p-9781119307471,

2. Alexandros Stefanakis, Ioannis Nikolaou, Circular Economy and Sustainability, ISBN: 9780128203965, Elsevier 2021, https://www.elsevier.com/books/circular-economy-and-sustainability/stefanakis/978-0-12-819817-9

3. Miguel Brandão, David Lazarevic, Göran Finnveden, Handbook of the Circular Economy, Edward Elgar Publishing Ltd, 2020 ISBN: 978 1 78897 271 0, https://www.e-elgar.com/shop/gbp/handbook-of-the-circular-economy-9781788972710.html

4. International Society for Industrial Ecology. (2015). A Short History of Industrial Ecology. www.is4ie.org/about/history

5. Sudhakara Reddy B., (2009), Energy Efficiency and Climate Change: Conserving Power for a Sustainable Future, Sage Publications Chennai

6. Charbel Jose Chiappetta Jabbour, Syed Abdul Rehman Khan, Sustainable Production and Consumption Systems, Springer Nature Singapore Pte Ltd. 2021, 978-981-16-4760-4, https://link.springer.com/book/10.1007/978-981-16-4760-4

7. *Syed Abdul Rehman Khan, Mirela Panait, Felix Puime Guillen, Lukman Raimi, Energy Transition Economic, Social and Environmental Dimensions, Springer Nature Singapore Pte Ltd. 2022, 978-981-19-3540-4,* https://doi.org/10.1007/978-981-19-3540-4
8. *Carlo Vezzoli, Ezio Manzini, Design for Environmental Sustainability, Springer-Verlag London 2008, https://doi.org/10.1007/978-1-84800-163-3*
9. *Carolina Machado, J. Paulo Davim, Circular Economy and Engineering, Springer Nature Switzerland AG 2020, https://doi.org/10.1007/978-3-030-43044-3*
10. *Sadhan Kumar Ghosh, Waste Management as Economic Industry Towards Circular Economy, Springer Nature Singapore Pte Ltd. 2020, https://doi.org/10.1007/978-981-15-1620-7*
11. *Roberta Salomone, Andrea Cecchin, Pauline Deutz, Andrea Raggi, Laura Cutaia, Industrial Symbiosis for the Circular Economy, Springer Cham 2020, https://doi.org/10.1007/978-3-030-36660-5*
12. *Lerwen Liu, Seeram Ramakrishna, An Introduction to Circular Economy, Springer Nature Singapore Pte Ltd. 2021, https://doi.org/10.1007/978-981-15-8510-4*

- *Related academic journals:*

1. International Journal of Environmental Research and Public Health https://www.mdpi.com/journal/ijerph
2. Sustainability, https://www.mdpi.com/journal/sustainability
3. Processes, https://www.mdpi.com/journal/processes
4. Energies, https://www.mdpi.com/journal/energies
5. Clean Technologies, https://www.mdpi.com/journal/cleantechnol
6. Applied Sciences, https://www.mdpi.com/journal/applsci
7. Journal of Industrial Ecology, https://onlinelibrary.wiley.com/journal/15309290
8. Journal of Cleaner Production, https://www.sciencedirect.com/journal/journal-of-cleaner-production
9. Resources, Conservation & Recycling, https://www.sciencedirect.com/journal/resources-conservation-and-recycling
10. Waste Management, https://www.sciencedirect.com/journal/waste-management
11. Recycling, https://www.mdpi.com/journal/recycling
12. Journal of Material Cycles and Waste Management, https://www.springer.com/journal/10163
13. Circular Economy and Sustainability, https://www.springer.com/journal/43615
14. Stochastic Environmental Research and Risk Assessment (SERRA), https://www.springer.com/journal/477
15. Journal of Environmental Health Science & Engineering, https://www.springer.com/journal/40201
16. Waste and Biomass Valorization, https://www.springer.com/journal/12649
17. International Journal of Environmental Science and Technology (IJEST),
18. Environmental Management, https://www.springer.com/journal/267
19. Environmental Monitoring and Assessment, https://www.springer.com/journal/10661
20. Environmental Sciences Europe, https://enveurope.springeropen.com/
21. Environmental Science and Pollution Research (ESPR), https://www.springer.com/journal/11356